

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
30 October 2003 (30.10.2003)

PCT

(10) International Publication Number
WO 03/089666 A3

(51) International Patent Classification⁷: G11C 13/02,
H01L 51/20, 51/30

(21) International Application Number: PCT/CA03/00574

(22) International Filing Date: 17 April 2003 (17.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/373,644 19 April 2002 (19.04.2002) US

(71) Applicant (for all designated States except US): UNIVERSITY OF SASKATCHEWAN TECHNOLOGIES INC.
[CA/CA]; Room 305, Kirk Hall, 117 Science Place, Saskatoon, Saskatchewan S7N 5C8 (CA).

(72) Inventors; and

(75) Inventors/Applicants (for US only): LEE, Jeremy, S. [CA/CA]; Department of Biochemistry, University of Saskatchewan, 107 Wiggins Road, Saskatoon, Saskatchewan S7N 5E5 (CA). WETTIG, Shawn, D. [CA/CA]; Department of Biochemistry, University of Saskatchewan, 107 Wiggins Road, Saskatoon,

Saskatchewan S7N 5E5 (CA). KRAATZ, Heinz-Bernhard [DE/CA]; Department of Chemistry, University of Saskatchewan, 110 Science Place, Saskatoon, Saskatchewan S7N 5C9 (CA).

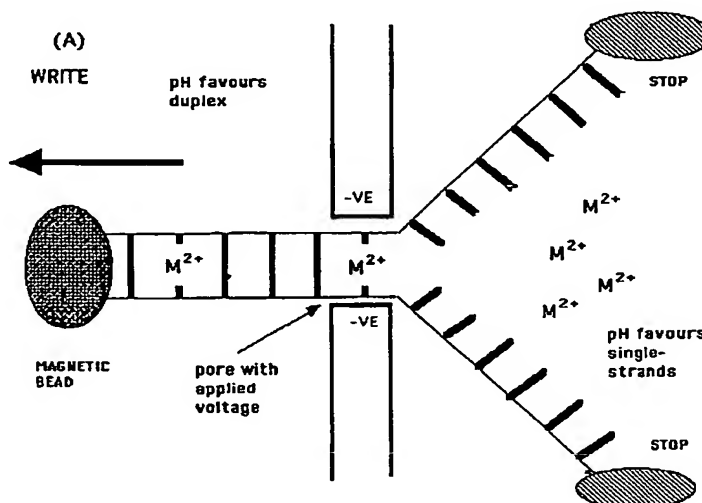
(74) Agent: SMART & BIGGAR; Attn: Robinson, J., Christopher, Box 11560, Vancouver Centre, 650 West Georgia Street, Suite 2200, Vancouver, British Columbia V6B 4N8 (CA).

(81) Designated States (national): AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,

[Continued on next page]

(54) Title: METHODS AND APPARATUS FOR MOLECULAR DATA STORAGE, RETRIEVAL AND ANALYSIS



(57) Abstract: In various aspects, the invention provides molecular systems for storing and retrieving information. In some embodiments, polymers capable of selectively binding metal ions, such as nucleic acids, are used to record information in the form of a particular molecular conformation. Electrochemical assay methods employing nanopores may be used to read and write information using such polymeric media. In some embodiments, information may be recorded in a nucleic acid polymer by magnetically modulating the translocation of the nucleic acid through a channel in a medium, while simultaneously modulating the electrostatic potential across the channel. In this way, the incorporation of a divalent metal ion in the nucleic acid duplex may be modulated to store information. In an alternative aspect, the invention provides analogous processes for detecting a base pair mismatch in a nucleic acid polymer.



ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:
18 December 2003

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/ 3/00574

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G11C13/02 H01L51/20 H01L51/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G11C H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99 31115 A (UNIV SASKATCHEWAN ; AICH PALOK (CA); LEE JEREMY S (CA)) 24 June 1999 (1999-06-24)	14
A	page 16, line 2-4	1-13
Y	US 6 015 714 A (AKESON MARK ET AL) 18 January 2000 (2000-01-18)	14
A	column 1, line 20 - column 6, line 14 figure 1	1-13
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

21 October 2003

Date of mailing of the international search report

03/11/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Colling, P

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/03/00574

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RAKITIN A ET AL: "METALLIC CONDUCTION THROUGH ENGINEERED DNA: DNA NANOELECTRONICS BUILDING BLOCKS" PHYSICAL REVIEW LETTERS, NEW YORK, NY, US, vol. 86, no. 16, 16 April 2001 (2001-04-16), pages 3670-3673, XP001100067 ISSN: 0031-9007 the whole document	1-14
A	KASIANOWICZ JOHN J ET AL: "Characterization of individual polynucleotide molecules using a membrane channel" PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF USA, NATIONAL ACADEMY OF SCIENCE. WASHINGTON, US, vol. 93, November 1996 (1996-11), pages 13770-13773, XP002139846 ISSN: 0027-8424 page 13770, left-hand column, paragraph 1 -page 13771, left-hand column, paragraph 2	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/JP93/00574

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9931115	A	24-06-1999	US 6432641 B1	13-08-2002
			AU 1656299 A	05-07-1999
			WO 9931115 A1	24-06-1999
			EP 1042344 A1	11-10-2000
			JP 2002508386 T	19-03-2002
			US 2003013672 A1	16-01-2003
<hr/>				
US 6015714	A	18-01-2000	US 5795782 A	18-08-1998
			US 2003044816 A1	06-03-2003
			US 6362002 B1	26-03-2002
			EP 0815438 A1	07-01-1998
			WO 9629593 A1	26-09-1996
<hr/>				